From Lithium to Uranium: Elemental Tracers of Early Cosmic Evolution
Proceedings IAU Symposium No. 228, 2005
V. Hill, P. François & F. Primas, eds.

doi:10.1017/S1743921305005338

The behaviour of Li abundance in the stars of different metallicities

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Abstract. Using the method of spectral synthesis we derived the abundances of Li in the atmospheres of 100 stars in the range of metallicities $-3 < [Fe/H] < 0.2$. The investigated spectra are part of the library collected at the Haute Provence Observatory and they were obtained with the 193 cm telescope equipped with ELODIE spectrometer (R=42000). For the metal-poor dwarfs, in the "Spite plateau" region ($[Fe/H] < -1.7$, $T_{\rm eff} > 5700$ K) we obtain $\log A(Li) = 2.30 \pm 0.05$, which is in a good agreement with the results of other authors. Our values of Li abundances do not indicate any trends either with $T_{\rm eff}$ or with [Fe/H]. The "plateau" is also traced in the metallicity range $-0.7 < [Fe/H] < -0.3$. The behavior of the lithium abundance for stars with $[Fe/H] > -1.7$ and $T_{\rm eff} < 5700$ K shows a depleting mechanism in these stars and the growth of its efficiency with an increase of the metallicity. The "lithium plateau" was also found for thick disk dwarfs with $T_{\rm eff} > 5800$ K.

Keywords. Stars: evolution, stars: abundances

1. Introduction

The distinguishing feature of the Li abundance behavior in metal-poor stars is that the halo dwarfs at $[Fe/H] < -1.5$ show almost the same Li abundance $\log A(Li) = 2.1$ (Spite & Spite, 1982). Spite & Spite (1982) suppose that the obtained value is the primordial abundance of Li. There is a large discussion of the following aspects: 1) the dispersion of the Li plateau values; 2) the trends of the Li abundance with [Fe/H] and $T_{\rm eff}$; 3) what physical processes of the transport and/or depletion might be acting in the plateau stars; 4) what is the value of the primordial lithium abundance? (Deliyannis, Pinsonneault & Duncan (1993); Gratton, Sneden, Carretta E. & Bragaglia (2000); Ryan, Norris & Beers (1999); Salaris & Weiss (2001); Thorburn (1994); Vauclair & Charbonnel (1998) etc.).

2. Observations, parameters and Li abundance determinations

The spectra were obtained with the 193 cm telescope (OHP) equipped with ELODIE spectrometer (R=42000)(Soubiran, Katz, & Cayrel 1998). The spectral range is 4400–6800 ÅÅ, S/N>100. The effective temperature $T_{\rm eff}$ were determined from the fitting of the far wings of H_α lines, *log* g values were obtained from ionization balance for iron, and $V_{\rm t}$ values were found by requiring of the iron abundances obtained from the given line of Fe I to be independent on its equivalent widths EW. The Li abundances in program stars were obtained by the STARSP LTE spectral synthesis code by Tsymbal (1996). A list of atomic and molecular lines was taken from (Mishenina & Tsymbal 1997).

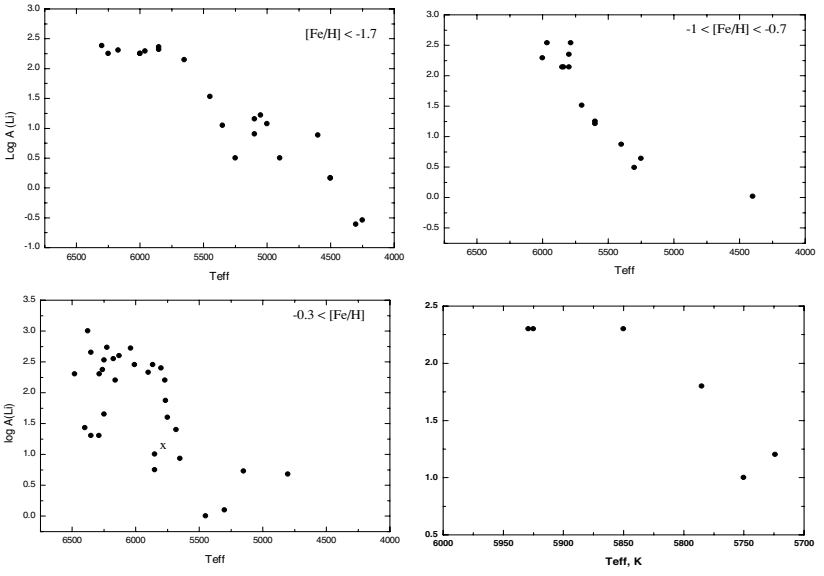

Figure 1. *log* A(Li) vs. $T_{\rm eff}$ for different metallicity stars (thick disk stars at bottom right)

3. Results and conclusions

The dependence of Li behavior on the temperature for the different metallicities is shown in Fig. 1. As one can see from Fig. 1 (top left), the most metal-poor stars show a very narrow plateau with the scatter of only ±0.058 dex. In a slightly more metal rich groups (top right), the plateau is observed too, but with a larger scatter (±0.17 dex), the values of the plateau is similar (2.31 dex). The plateau extends up to [Fe/H]=–0.3. The behavior of the Li abundance with temperature for different metallicity groups indicates that efficiency of the transport mechanisms increases with the metallicity. We confirm the bimodal distribution of Li for stars around solar [Fe/H] and $T_{\rm eff} > 5600$ K (bottom left, the cross marks the Sun).

We found also the "lithium plateau" (bottom right) for the thick disk dwarfs ($T_{\rm eff} > 5800$ K), that we have selected on kinematical criterion. The behavior of the lithium abundance in stars with $T_{\rm eff} < 5600$ K supports the existence of some depleting mechanism.

Acknowledgements

We would like to acknowledge Dr. V. Kovtyukh for some comments and we also thank the organisers for the financial support by IAU grant.

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https://doi.org/10.1017/S1743921305005338 Published online by Cambridge University Press